THE EFFECTS OF THE AMOUNTS OF AVAILABLE PLANT NUTRIENTS PRESENT IN THE SOIL UPON THE COMPOSITION OF CROPS

BY

ALTO ELDO ROYER

B.S., Purdue University, 1941
M.S., Purdue University, 1947

AN ABSTRACT OF A THESIS

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF DOCTOR OF PHILOSOPHY IN AGRONOMY
IN THE GRADUATE COLLEGE OF THE
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I. Introduction

Many factors affect the composition of plants. Such factors as season, climate, variety, stage of growth, and others are said to have much more pronounced effects upon plant composition than do the amounts of the available plant nutrients present in the soil. Many workers recognize that the amounts of the available plant nutrients in the soil do influence plant composition, but the relationships between these have not been worked out.

II. Procedure

It was desired to correlate the phosphorus and potassium compositions of various crops with the soil tests being used extensively in Illinois for these two elements.

Samples of red clover, corn and soybeans were taken mainly from the standard series of treatments which occur on most Illinois experimental fields. These provided adjacent pairs of plots with phosphorus and potassium as single nutrient variables. Soil samples were taken in the immediate vicinity of the plant samples.

The plant compositions from the various fields were reduced to comparable levels by computing composition ratios. For a particular crop and nutrient this was defined as the ratio between the percent of the nutrient in the plant material from the untreated plot divided by the percent of the nutrient in the plant material from the fully treated plot.

III. Results And Conclusions

When the phosphorus composition ratios and percent

yields for red clover, corn stover and corn grain were plotted against the soil psosphorus tests, it was found that both the phosphorus compositions and yields increased with increasing soil test. The phosphorus composition of red clover increased until the soil test reached 20 pounds of phosphorus per acre, but increased very gradually as the soil test was increased above 20 pounds per acre. The phosphorus composition of corn grain and stover increased rapidly up to 30 to 35 pounds per acre of available phosphorus, but increased slowly above 30 to 35 pounds per acre. Investigators who found little or no increase in phosphorus composition for phosphorus fertilization were probably working with soils that had 30 or more pounds per acre of available phorphorus.

It was not possible to determine a definite relationship between the soil test value and the absolute percentages of phosphorus in red clover, corn stover or corn grain.

When the potassium composition ratios and percent yields were related to the soil potassium tests, it was found that additional potassium at low soil test values resulted in large yield increases and only small increases in potassium composition. At medium to high soil test values, additional potassium resulted in large increases in potassium composition but small yield increases. The largest increase in potassium composition of red clover occurred above 100 pounds per acre of available potassium, while that for corn stover occurred above 180 pounds per acre. When the percentage potassium in stover and red clover were plotted against the soil test value, the relationship was essentially the same as when the composition ratios were used. The amount of available soil potassium had a predominant influence upon the potassium composition.

When the potassium composition of stover from potassium treated plots was related to the soil base-exchange capacity, it was found that the potassium composition decreased as the exchange capacity increased. This was explained by the fact that potassium added to a soil of high base-exchange capacity

encountered greater cation competition for absorption by the plant.

The potassium composition of corn grain was not significantly affected by potassium fertilization. With relatively large amounts of potassium and calcium in the stover as compared with the grain, their content in the grain should be rather constantly maintained by drawing upon that in the stover. With larger amounts of phosphorus and nitrogen being deposited in the corn grain, differences in the soil supply should be reflected in the composition of the grain.

VITA

Alto Eldo Royer was born on September 19, 1917, in Coalmont, Indiana. After graduating from Lewis Township High School in 1936, he entered Purdue University in 1938 and received the degree of Bachelor of Science from that institution in June 1941. He was commissioned a second lieutenant in the Officers' Reserve Corps in June 1941. In July of the same year he was called to active duty in the Army of the United States and served in the Pacific, American and European Theaters. Upon separation from the army in 1946, he entered the Graduate College of Purdue University and received the degree of Master of Science from that institution in June 1947. He held a Research Assistantship from January 1946 to June 1947. From August 1947 to January 1949 he held the position of Assistant Soil Chemist and Assistant Professor of Soils with the Alabama Polytechnic Institute. He entered the Graduate College of the University of Illinois in February 1949. He held a research assistantship from March 1949 to June 1951. He is a member of Sigma Xi and Gamma Sigma Delta.

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